Composite Materials Production Methods Developed

ENERGY EFFICIENCY AND RENEWABLE ENERGY

OFFICE OF TRANSPORTATION TECHNOLOGIES

Transportation

FOR THE 21ST CENTURY

Background

A critical step to achieving significant reductions in fuel use is the development of technologies that reduce the weight of the vehicle. The use of glass-reinforced polymers as structural components can yield a 20 to 30% reduction in vehicle weight.

As part of the Partnership for a New Generation of Vehicles (PNGV), a major goal of the Automotive Lightweighting Materials (ALM) program is to develop materials and primary processing methods for the fabrication of lighter-weight components that can be incorporated into automotive systems. In the first phase of the ALM program, composite materials research is concentrated on developing the technologies to make glass-reinforced composites technically and commercially viable. The program's focus areas include long-term durability, adhesive joining technologies, high-volume processing of medium to large parts, crash testing and crash modeling of composite structures, and post-assembly, non-destructive evaluation.

The Technology

In cooperation with the Automotive Composites Consortium of the United States Council for Automotive Research (USCAR), a project was undertaken to investigate the manufacture of a large structural composite component in volumes of 50,000 units per year using a new preforming technology called P-4 . A composite pickup box was chosen for the demonstration with the goal of achieving a 25% weight reduction while maintaining cost parity with a comparable steel truck box. In addition, it was designed to be structurally adhesive-bonded to the frame. Key elements of the research that were incorporated into this successful demonstration project include the following:

1. The development of durability-driven design guidelines for composite materials. These include the synergistic effects of creep, fatigue, fracture, impact, temperature extremes, fluid exposure, and other environmental stressors.
2. The evaluation of real time non-destructive testing methods for quality control.
3. The development of adhesive joint test methodologies and novel design approaches.
4. Successful incorporation of the new P-4 preforming technology for the placement of glass fibers at high production rates prior to composite molding.
5. The development of high-volume liquid molding technologies with cycle times of four minutes for large parts.

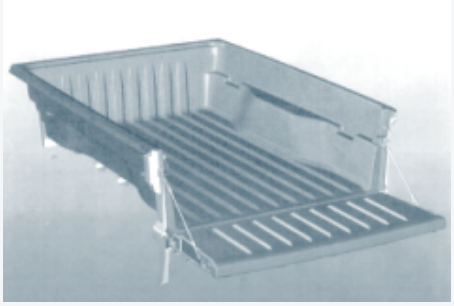
A very important part of the project was a partnership with major suppliers to enhance their capabilities, and thus increase the opportunity for commercialization.

Commercialization

The first application for the new composite materials technologies is in the manufacture of the pickup box for the 2001 Chevrolet Silverado, which was named one of the Ten Best Innovations of the Year by *Popular Science.* The pickup box structure for the Silverado is 50 pounds lighter and has a 15-pound lighter tailgate than its steel counterpart. It has demonstrated impact and corrosion resistance that is far superior to comparable steel truck beds. Another composite application that has been announced and which drew from improvements in durability and adhesive bonding is the Ford Explorer Sport Trac, which will contain an all-composite, one-piece sport utility vehicle/truck bed. The Sport Trac's composite bed is 30% lighter than its steel counterpart which is composed of 40 separate parts. It has a $20M welding and assembly cost reduction associated with its introduction.

Benefits

- **P-4 composite pickup truck boxes could save 110 million gallons of fuel per year**
- **P-4 composite parts are 20 to 30% lighter than steel**
- **Large composite parts can replace many smaller steel parts**
- **Significant savings in tooling and assembly costs**
- **Excellent dent and corrosion resistance**



Composite pickup box manufactured using P-4 preforming technology for the rapid placement of glass fibers

Contacts:

Joseph Carpenter
Office of Transportation Technologies
(202) 586-1022
joseph.carpenter@ee.doe.gov

Dave Warren
Oak Ridge National Laboratory
(865) 574-9693
w95@ornl.gov